

**CLAIMS:**

1. An integrated variable optical attenuator comprising:

5 a polarization element for continuously varying the state of polarization of polarized light incoming to said integrated variable optical attenuator responsive to a control signal; and

a polarization-sensitive optical isolator fixed with respect to said polarization element so that the amount of light polarized light passing through said polarization element and said polarization-sensitive optical isolator can be varied by said control  
10 signal.

2. The integrated variable optical attenuator of claim 1 wherein said polarization element comprises a liquid crystal cell.

3. The integrated variable optical attenuator of claim 2 wherein said liquid crystal cell comprises a liquid crystal material selected from the group comprising PAN  
15 liquid crystal, TN liquid crystal, and HAN liquid crystal.

4. The integrated variable optical attenuator of claim 2 wherein said polarization element comprises a PLZT phase retarder.

5. The integrated variable optical attenuator of claim 2 wherein said polarization element comprises a low saturation field, garnet Faraday rotator.

6. The integrated variable optical attenuator of claim 1 wherein said polarization-sensitive optical isolator comprises a first linear polarizer proximate said polarization element, a Faraday rotator in fixed relationship to said first linear polarizer,  
5 and a second linear polarizer in fixed relationship to said Faraday rotator.

7. The integrated variable optical attenuator of claim 6 wherein said first and second linear polarizer comprise first and second polarization gratings respectively.

8. The integrated variable optical attenuator of claim 1 wherein said polarization-sensitive optical isolator comprises a first linear polarizer proximate said  
10 polarization element, a half-wave plate, a Faraday rotator and a second linear polarizer.

9. The integrated variable optical attenuator of claim 6 wherein said polarization-sensitive optical isolator comprises  
a first element proximate polarization element, said first element selected from the group comprising a birefringent crystal and a linear polarizer; and  
15 a quarter-wave plate.

10. An integrated variable optical attenuator comprising:  
a liquid crystal cell having first and second plates, each having an electrode mounted thereon, said liquid crystal cell rotating polarized light responsive to the amount of voltage applied between said electrodes; and

a polarization-sensitive optical isolator core fixed to said liquid crystal cell, said optical isolator core having a first polarizer, a Faraday rotator, and a second polarizer arranged with respect to each other so that the amount of polarized light from said liquid crystal cell passing through said first polarizer is controlled by said amount of voltage applied between said liquid crystal cell electrodes, and light passing through said second polarizer and said Faraday rotator to said first polarizer is blocked.

11. The integrated variable optical attenuator of claim 10 wherein liquid crystal cell comprises material is selected from the group comprising PAN liquid crystal, TN liquid crystal, and HAN liquid crystal.

12. The integrated variable optical attenuator of claim 10 wherein said first polarizer comprises a linear polarizer having a first transmission axis, and said second polarizer comprises a linear polarizer having a second transmission axis aligned at 45° from said first transmission axis.

13. The integrated variable optical attenuator of claim 12 wherein said transmission axis is aligned with polarized light from said liquid crystal cell with no voltage applied between said electrodes.

14. The integrated variable optical attenuator of claim 12 wherein said transmission axis is aligned at 90° with polarized light from said liquid crystal cell with no voltage applied between said electrodes.

15. An integrated laser diode assembly comprising:

a laser diode;

a first lens proximate said laser diode, said first lens arranged and oriented with  
5 respect to said laser diode to collimate light from said laser diode;

an integrated variable optical attenuator proximate said first lens opposite said  
laser diode, said integrated variable optical attenuator arranged and oriented to receive  
collimated light from said first lens, said integrated variable optical attenuator further  
comprising:

10 a liquid crystal cell having first and second plates, each plate having an electrode  
mounted thereon, said liquid crystal cell rotating polarized light responsive to the amount  
of voltage applied between said electrodes, said first plate proximate and facing said first  
lens; and

an optical isolator core having a first polarizer fixed to said second plate of said  
15 liquid crystal cell, a Faraday rotator fixed to said first polarizer, and a second polarizer  
fixed to said Faraday rotator, the amount of polarized light passing through said liquid  
crystal cell and said optical isolator core controlled by the amount of voltage applied  
between said electrodes of said liquid crystal cell;

a second lens proximate said second polarizer of said optical isolator core  
20 opposite said Faraday rotator, said second lens arranged and oriented to focus light from  
said integrated variable optical attenuator, and

a section of output optical fiber having an end, said output optical fiber section arranged and oriented with respect to said second lens so that light from said second lens is focused at said end of said output optical fiber section.

5           16.     The integrated laser diode assembly of claim 15 wherein output light from said laser diode is linearly polarized in a first direction and said first polarizer comprises a linear polarizer having a first transmission axis aligned along said first direction.

          17.     The integrated laser diode assembly of claim 16 wherein said second polarizer comprises a linear polarizer having a second transmission axis aligned at 45°  
10 with respect to said first transmission axis.

          18.     The integrated laser diode assembly of claim 15 further comprising:  
  
          a base, said laser diode, first lens, integrated variable optical attenuator; second lens and said end of said output optical fiber section mounted thereto; and  
  
          a package enclosing said base, said laser diode, first lens, integrated variable  
15 optical attenuator and second lens, a portion of said output optical fiber section removed from said end mounted to said package.

          19.     The integrated laser diode assembly of claim 15 further comprising:  
  
          a base, said laser diode, first lens, and integrated variable optical attenuator mounted thereto; and

a package enclosing said base, said laser diode, first lens, and integrated variable optical attenuator, said second lens, a portion of said output optical fiber section including said end mounted to said package.

5           20.     The integrated laser diode assembly of claim 15 further comprising:

a package enclosing and mounting said base, laser diode, first lens, and integrated variable optical attenuator, second lens, a portion of said output optical fiber section including said end mounted to said package.

10           21.     The integrated laser diode assembly of claim 20 wherein said laser diode is mounted in a laser diode package and said laser diode package is mounted to said package.

22.     The integrated laser diode assembly of claim 21 wherein said laser diode package comprises further comprising a TO-can.